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## XVII. Science and Technology/Engineering, Grade 8

## Grade 8 Science and Technology/Engineering Test

The spring 2006 Grade 8 MCAS Science and Technology/Engineering Test was based on learning standards in the Massachusetts *Science and Technology/Engineering Curriculum Framework* (2001). The *Framework* identifies four major content strands listed below. Page numbers for the grades 6–8 learning standards appear in parentheses.

- Earth and Space Science (*Framework*, pages 29–30)
- Life Science (Biology) (*Framework*, pages 46–48)
- Physical Sciences (Chemistry and Physics) (*Framework*, pages 60–62)
- Technology/Engineering (*Framework*, pages 76–79)

The *Science and Technology/Engineering Curriculum Framework* is available on the Department Web site at [www.doe.mass.edu/frameworks/scitech/2001/0501.pdf](http://www.doe.mass.edu/frameworks/scitech/2001/0501.pdf).

In *Test Item Analysis Reports* and on the *Subject Area Subscore* pages of the MCAS *School Reports* and *District Reports*, Science and Technology/Engineering test results are reported under four MCAS reporting categories, which are identical to the four *Curriculum Framework* content strands listed above.

### Test Sessions

The MCAS Grade 8 Science and Technology/Engineering Test included two separate test sessions. Each session included multiple-choice and open-response questions.

### Reference Materials and Tools

The use of bilingual word-to-word dictionaries was allowed for limited English proficient students only, during both Science and Technology/Engineering test sessions. No other reference tools or materials were allowed.

### Cross-Reference Information

The table at the conclusion of this chapter indicates each item's reporting category and the *Framework* learning standard it assesses. The correct answers for multiple-choice questions are also displayed in the table.

# Science and Technology/Engineering

## SESSION 1

### DIRECTIONS

This session contains seventeen multiple-choice questions and two open-response questions. Mark your answers to these questions in the spaces provided in your Student Answer Booklet.

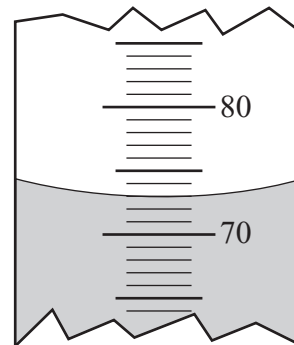
- 1 The terms gas exchange, diaphragm, and inhale are **most** closely associated with which system in the human body?

A. circulatory  
B. digestive  
C. excretory  
D. respiratory

- 2 What are the basic structural units of living organisms?

A. cells  
B. nuclei  
C. organs  
D. tissues

- 3 The drawing below shows part of a graduated cylinder containing liquid.



Based on the sensitivity of the graduated cylinder, what is the volume of the liquid?

A. 70.5 mL  
B. 73.0 mL  
C. 76.7 mL  
D. 87.0 mL

- 4 Where is an igneous rock such as pumice most likely formed?

A. in a desert  
B. in a creek bed  
C. near a volcano  
D. under a glacier

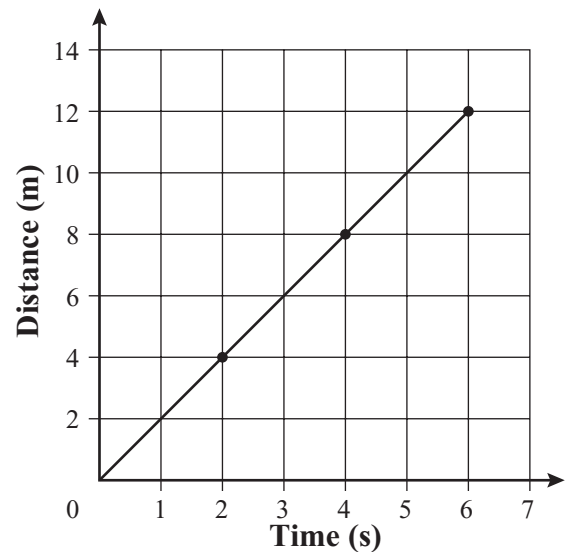
- 5 The illustration below shows a cloth banner made to advertise a county fair.



This sign will be hung across the main street of a town between two metal utility poles. Which of the following materials would be the **best** to use to attach the sign to the poles?

- A. nails
- B. ropes
- C. staples
- D. tape

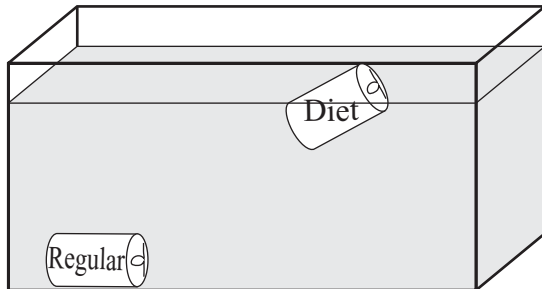
- 6 The graph below relates distance to time for a rolling ball.



What is the average speed of the ball?

- A. 2 m/s
- B. 6 m/s
- C. 8 m/s
- D. 72 m/s

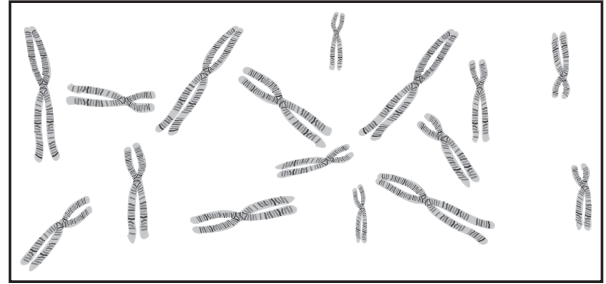
- 7 The diagram below shows what occurred when a can of diet soda and a can of regular soda were dropped into a container of water.



The can of regular soda sank to the bottom of the container, but the can of diet soda floated. Which of the following statements **best** explains this observation?

- A. The can of regular soda is less dense than the can of diet soda.
- B. The can of regular soda is more dense than the can of diet soda.
- C. The can of regular soda has a larger volume than the can of diet soda.
- D. The can of regular soda has a smaller volume than the can of diet soda.

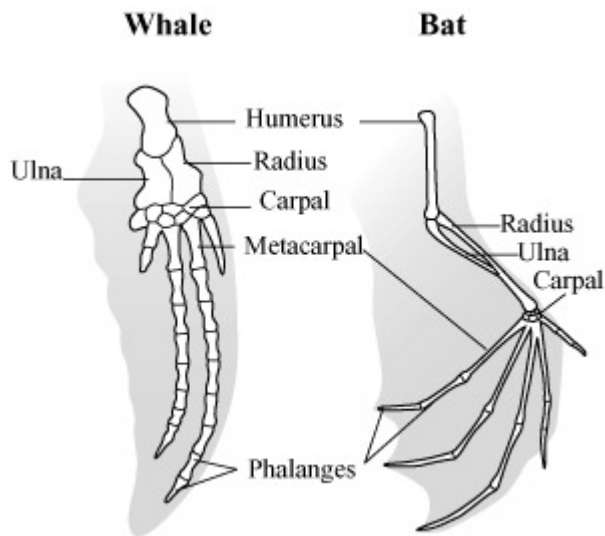
- 8 The diagram below shows the chromosomes from a cell after they were photographed under a microscope.



Which of the following questions may **best** be answered by studying an organism's chromosomes?

- A. What sex is the organism?
- B. Is the organism endangered?
- C. Where is the organism's ecosystem?
- D. How does the organism obtain its food?

- 9 The bones of a whale flipper are similar to the bones of a bat wing as shown in the illustration below.



What does this similarity in bone structure suggest about the whale and the bat?

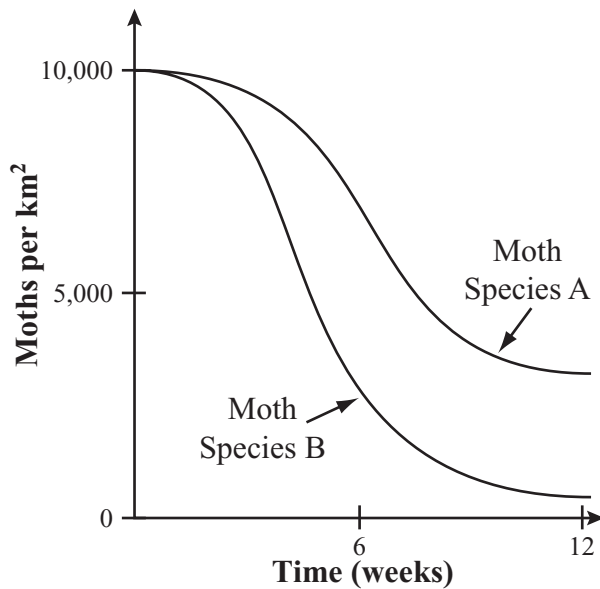
- A. They use the same methods to travel.
- B. They evolved from a common ancestor.
- C. They can migrate to the same locations.
- D. They can manipulate objects in the same way.

- 10 A student in a laboratory transfers a beaker containing a hot solution from the lab table to a cool water bath.

Which of the following parts of the system experiences an increase in heat energy?

- A. beaker
- B. lab table
- C. solution
- D. water bath

- 11 The praying mantis is a predatory insect that often eats moths. The graph below shows the relative numbers of two species of moths over 12 weeks after the introduction of the predatory praying mantis.



What characteristic of this ecosystem is **best** indicated from this graph?

- A. Species B was preferred as food over species A.
- B. Species B may replace species A in this environment.
- C. Species B will reproduce more rapidly than species A.
- D. Species B was more abundant at the beginning of this time period than species A.

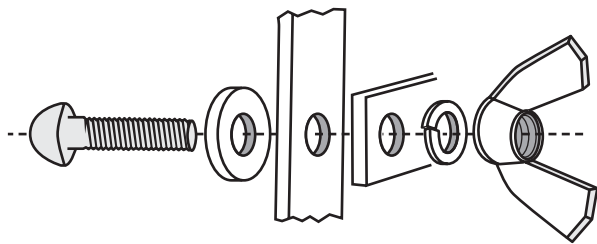
- 12 An engineer is analyzing which areas in a city might become flooded if there are heavy rains. Which of the following maps is **best** to use for this analysis?

- A. a map showing the routes of city buses
- B. a map showing the locations of streets
- C. a map showing the locations of houses
- D. a map showing the elevations of ground surfaces

- 13 From year to year, farmers rotate different crops in the fields to improve soil nutrients. Why is crop rotation also an effective pest management method?

- A. It allows chemicals to kill more pests.
- B. It creates crops that are pest-resistant.
- C. It interrupts the life cycles of pests.
- D. It allows pests to overpopulate.

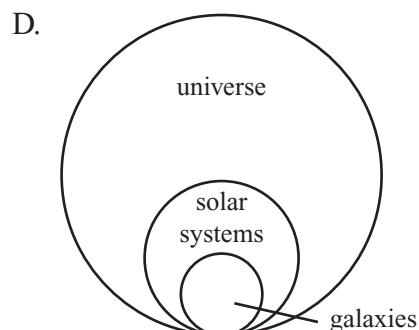
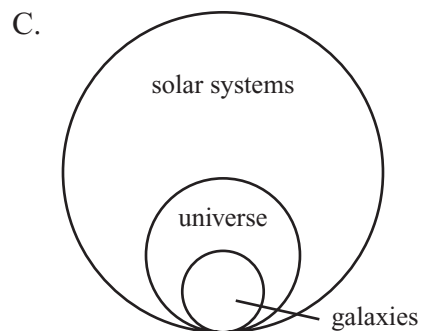
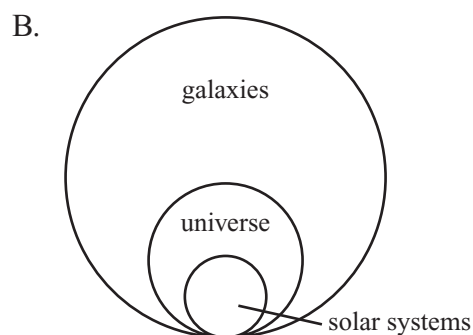
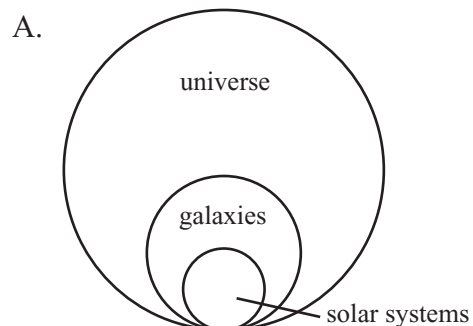
- 14 The diagram below illustrates a step in the assembly process for a swing set.



Which of the following is the **best** reason to use this type of drawing when assembling this swing set?

- A. to indicate the tools needed
- B. to warn of potential hazards
- C. to increase the scale of the parts
- D. to show how the parts go together

- 15 Which of the following diagrams **best** represents the relationship between galaxies, the universe, and solar systems?

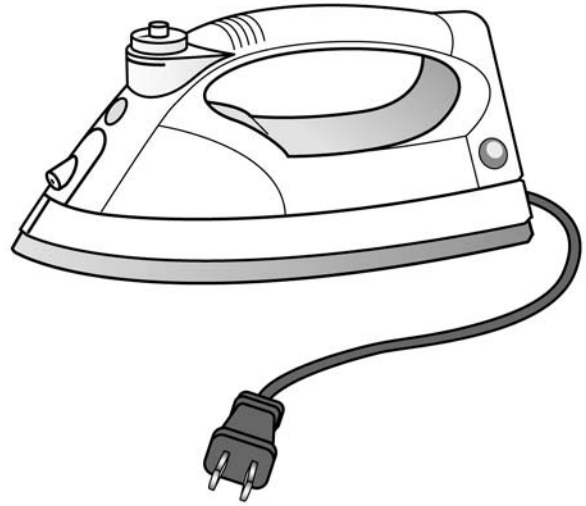




- 16 A researcher found shark fossils on top of a mountain. This evidence suggests which of the following about this region?

A. It was once below a waterfall.  
B. It was once part of a riverbed.  
C. It was once covered by an ocean.  
D. It was once near a freshwater lake.

- 17 The picture below shows an iron.



When considering an iron as an example of a system, what is the input?

A. electricity  
B. temperature  
C. motion on clothes  
D. steam from the plate

Questions 18 and 19 are open-response questions.

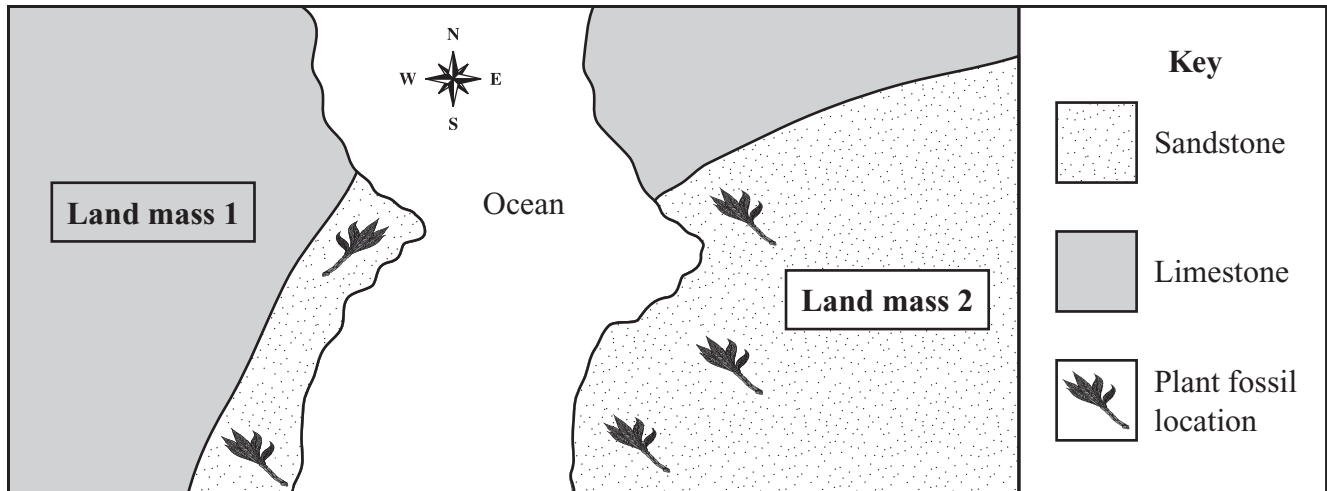
- **BE SURE TO ANSWER AND LABEL ALL PARTS OF EACH QUESTION.**
- **Show all your work (diagrams, tables, or computations) in your Student Answer Booklet.**
- **If you do the work in your head, explain in writing how you did the work.**

**Write your answer to question 18 in the space provided in your Student Answer Booklet.**

- 18** A new type of sneaker is being designed for athletes who play on hard surfaces.
- List **three** divisions of the manufacturing organization involved in the design, manufacture, and promotion of this new style of sneaker.
  - Describe the general role of **each** division you identified in part (a).

Write your answer to question 19 in the space provided in your Student Answer Booklet.

- 19 The diagram below shows two land masses separated by an ocean.



A scientist is studying these two land masses. The scientist hypothesizes that the land masses were once together.

- Using the diagram, identify **two** pieces of evidence that support the scientist's theory that the land masses were once together.
- Explain how **each** piece of evidence you identified supports the scientist's hypothesis.

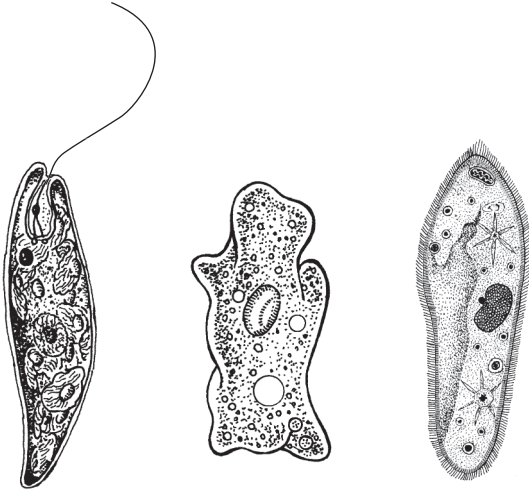
# Science and Technology/Engineering

## SESSION 2

### DIRECTIONS

This session contains seventeen multiple-choice questions and three open-response questions. Mark your answers to these questions in the spaces provided in your Student Answer Booklet.

- 20 The illustration below shows three types of unicellular organisms commonly found in pond water.



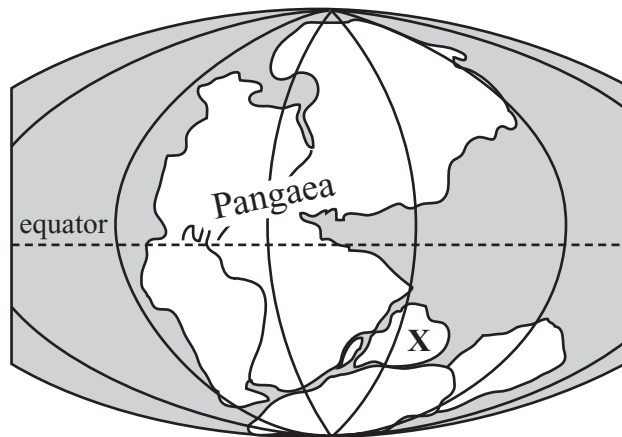
Based on the illustration, which of the following can be used to separate these organisms into three different groups?

- A. length of lifespan
- B. number of offspring
- C. presence of a nucleus
- D. method of movement

- 21 Which of the following is the best example of a part of the propulsion system of a tractor?

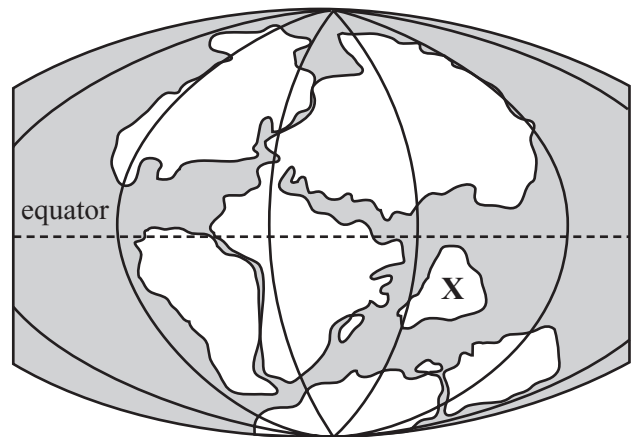
- A. engine
- B. front headlight
- C. hood
- D. steering wheel

- 22 About 300 million years ago, the land of Earth was in a single mass known as Pangaea, as shown in Figure A. About 150 million years ago, Pangaea broke up into the land masses shown in Figure B.



300 million years ago

**Figure A**



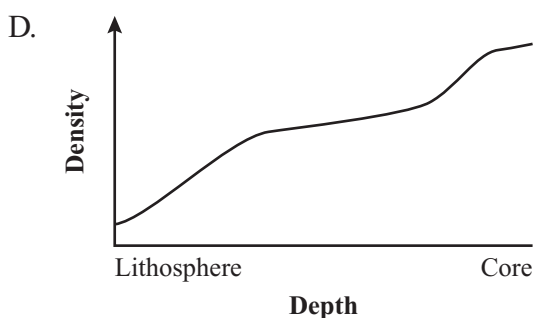
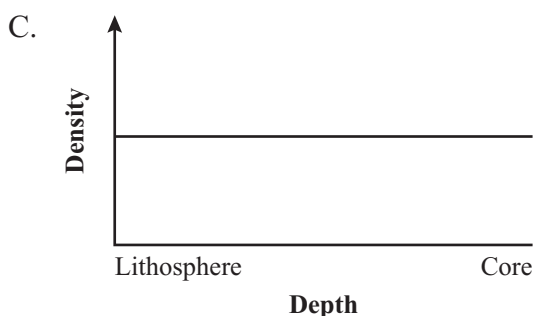
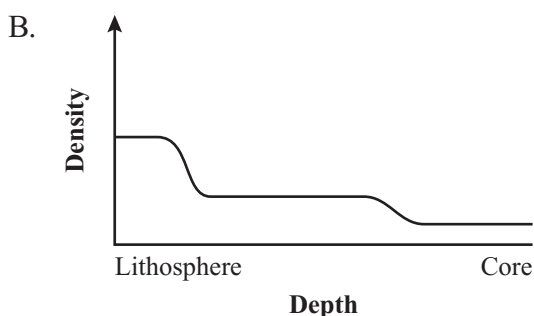
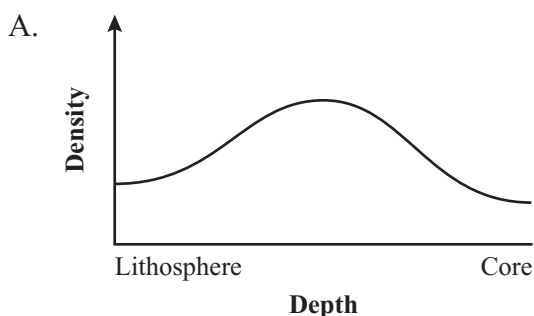
150 million years ago

**Figure B**

Based on the diagrams, which of the following were **more likely** to survive on continent X after the breakup of Pangaea than before it broke apart?

- A. organisms that lived in fresh water
- B. organisms that required warm conditions
- C. organisms that hibernated for long periods
- D. organisms that traveled great distances during migrations

- 23 Which of the following graphs **best** represents the relationship between density and depth of material below Earth's surface?



- 24 A glass is partially filled with water. Five ice cubes are placed in the glass, causing the level of the water to reach the rim of the glass. Which of the following statements **best** explains the increase in water level?

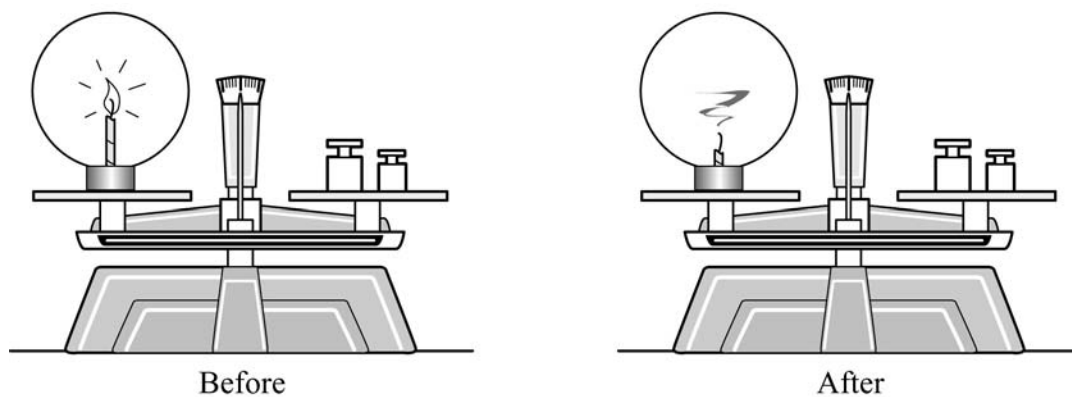
- A. The volume of the submerged ice is equal to the volume of water displaced.
- B. The mass of the water in the glass is less than the mass of the ice.
- C. The weight of the ice is less than the weight of the water in the glass.
- D. The density of the water in the glass is greater than the density of the ice.

- 25 Sal is looking at a map of Massachusetts. He has measured the distance, in inches, from Boston to Salem on the map. He wants to know how many actual miles the inches represent.

What feature of the map should he look for?

- A. key
- B. scale
- C. legend
- D. compass

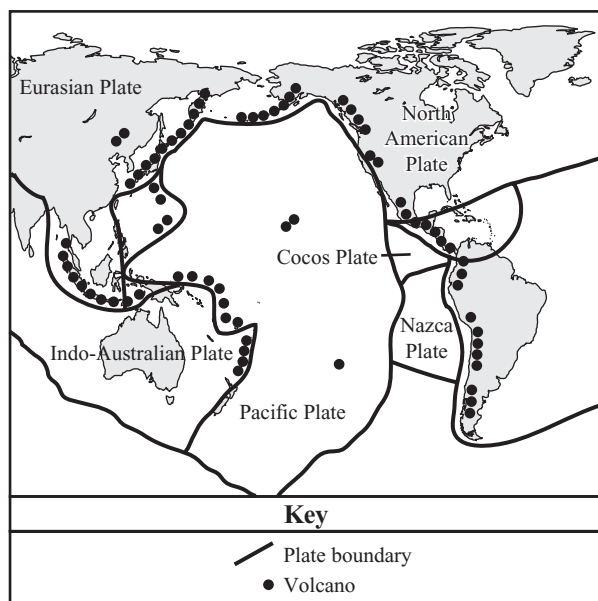
- 26 The diagram below shows a balance being used to measure a burning candle in a sealed glass ball before and after the burning is complete.



As the candle burns, the size of the candle decreases, but the reading on the balance does not change. Which of the following is demonstrated by this experiment?

- A. The total mass of the system is constant.
- B. Energy is converted to mass when the candle is burned.
- C. Smoke particles have more mass than molecules of candle wax.
- D. Kinetic energy is converted to potential energy when the candle is burned.

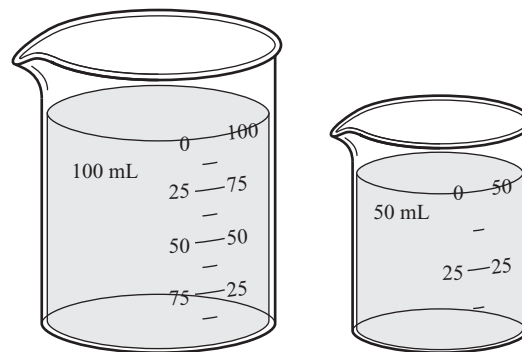
- 27 On the map below, dark circles indicate the positions of volcanoes in the “Ring of Fire” in and around the Pacific Ocean. Dark lines indicate tectonic plate boundaries of Earth’s crust.



According to this map, which of the following describes where volcanoes are **most likely** to form in the Ring of Fire?

- A. Volcanoes form in the middle of a tectonic plate.
- B. Volcanoes form below the surface of tectonic plates.
- C. Volcanoes form where tectonic plates meet other plates.
- D. Volcanoes form where earthquakes are least likely to occur.

- 28 The two beakers below contain pure water.



Which of the following properties is the same for both of these samples?

- A. mass
- B. weight
- C. volume
- D. boiling point

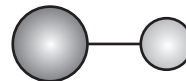


- 29 Index fossils help scientists estimate the age of a rock because index fossil species only existed for a relatively short time. What happened to the species that are now used as index fossils?

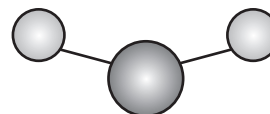
A. They became extinct.  
B. They changed their diets.  
C. They hid in marine sediments.  
D. They migrated to new environments.

- 30 Below are four ball-and-stick models representing compounds. Which of these models **best** represents ammonia ( $\text{NH}_3$ )?

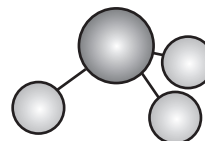
A.



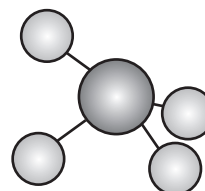
B.



C.



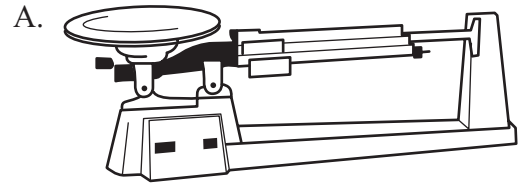
D.



- 31 Students are studying the process of photosynthesis in plants. Which of the following is a product of photosynthesis?

A. carbon dioxide  
B. nitrogen  
C. sodium chloride  
D. sugar

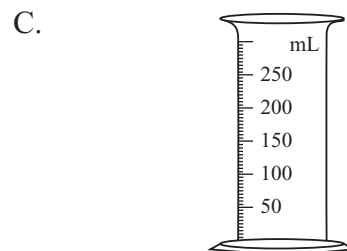
- 32 Which of the following instruments is **best** to use to measure the volume of a small irregularly shaped solid?



Triple beam balance



Ruler

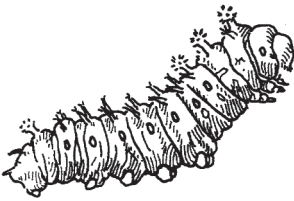


Graduated cylinder

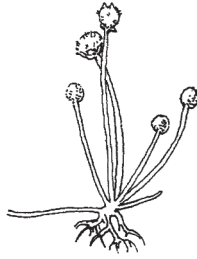


Thermometer

- 33 The following diagram shows a caterpillar, mold, and a fern.



Caterpillar



Mold



Fern

What do these organisms have in common?

- A. They are made of cells.
- B. They produce their own food.
- C. They decompose other organisms.
- D. They are disease-causing organisms.

34 *Spirogyra* are green algae that can reproduce sexually. Which of the following features identifies reproduction in *Spirogyra* as sexual reproduction?

- A. The cells of parent algae have nuclei.
- B. Each offspring contains chloroplasts.
- C. Several offspring may be produced at once.
- D. Genetic material is contributed by two parent cells.

35 The Moon orbits Earth at a speed of approximately one kilometer per second. The Moon is kept in orbit by which of the following?

- A. gravity
- B. lunar phases
- C. magnetism
- D. ocean tides

36 The illustration below shows an architect's model of an office building.



Which of the following is **most likely** the purpose of this model?

- A. to guide the drafting of the building's plans
- B. to test the strength of the construction technique
- C. to inventory the materials needed for construction
- D. to show some of the characteristics of the finished structure

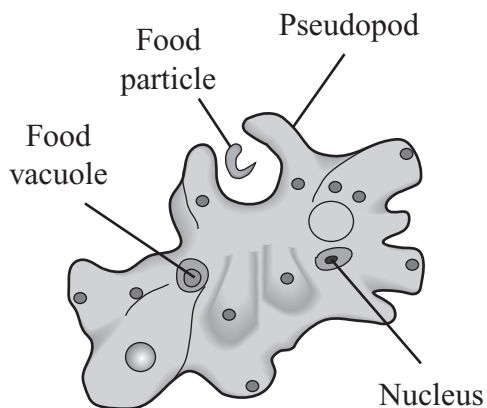
Questions 37 through 39 are open-response questions.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF EACH QUESTION.**
- **Show all your work (diagrams, tables, or computations) in your Student Answer Booklet.**
- **If you do the work in your head, explain in writing how you did the work.**

Write your answer to question 37 in the space provided in your Student Answer Booklet.

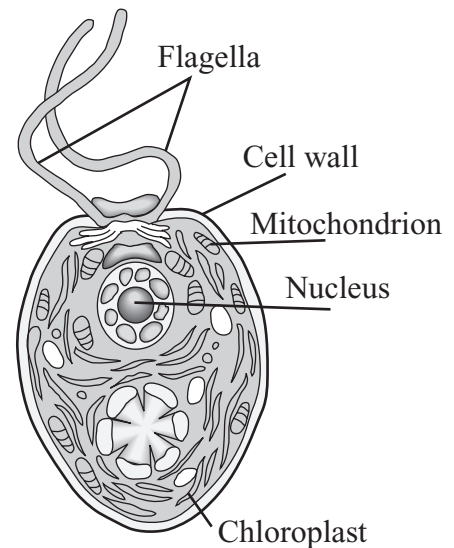
- 37** The diagrams below show an *Amoeba* and a *Chlamydomonas*.

**Diagram A**



*Amoeba* 0 100  $\mu\text{m}$

**Diagram B**



*Chlamydomonas* 0 5  $\mu\text{m}$

Both organisms can be seen only with a microscope. Since these are one-celled organisms, each cell must be able to carry out all important life functions, such as moving from place to place and getting food.

- Compare the ways these two organisms move. Be sure to include information from the diagrams in your answer.
- Compare the ways these two organisms obtain nutrients. Be sure to include information from the diagrams in your answer.

Write your answer to question 38 in the space provided in your Student Answer Booklet.

- 38** A science class is studying physical and chemical changes.

The teacher puts a beaker of water onto a hot plate and heats it until bubbles appear.

- a. Classify this as a physical or chemical change. Explain your reasoning using specific details.

The teacher puts a sugar cube into a container of warm water. Eventually the sugar cube is no longer visible.

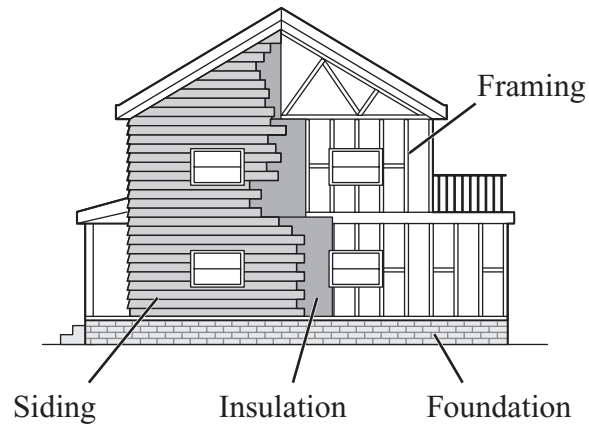
- b. Classify this as a physical or chemical change. Explain your reasoning using specific details.

The teacher pours vinegar into a small container of baking soda. The combined substances begin to fizz and bubble as a gas is released.

- c. Classify this as a physical or chemical change. Explain your reasoning using specific details.

Write your answer to question 39 in the space provided in your Student Answer Booklet.

- 39 The diagram below shows several labeled parts of a house.



- Describe the function of the house's foundation.
- The framing, insulation, and siding make up the wall system of this house. Explain the function of **each** of these parts.

**Grade 8 Science and Technology/Engineering  
Spring 2006 Released Items:  
Reporting Categories, Standards, and Correct Answers**

Item No.	Page No.	Reporting Category	Standard	Correct Answer (MC)*
1	399	<i>Life Science (Biology)</i>	6	D
2	399	<i>Life Science (Biology)</i>	5	A
3	399	<i>Physical Sciences (Chemistry and Physics)</i>	3	B
4	399	<i>Earth and Space Science</i>	6	C
5	400	<i>Technology/Engineering</i>	1.1	B
6	400	<i>Physical Sciences (Chemistry and Physics)</i>	12	A
7	401	<i>Physical Sciences (Chemistry and Physics)</i>	2	B
8	401	<i>Life Science (Biology)</i>	8	A
9	402	<i>Life Science (Biology)</i>	11	B
10	402	<i>Physical Sciences (Chemistry and Physics)</i>	14	D
11	403	<i>Life Science (Biology)</i>	13	A
12	403	<i>Earth and Space Science</i>	1	D
13	403	<i>Technology/Engineering</i>	7.2	C
14	404	<i>Technology/Engineering</i>	2.2	D
15	404	<i>Earth and Space Science</i>	12	A
16	405	<i>Earth and Space Science</i>	7	C
17	405	<i>Technology/Engineering</i>	2.6	A
18	406	<i>Technology/Engineering</i>	4.3	
19	407	<i>Earth and Space Science</i>	7	
20	408	<i>Life Science (Biology)</i>	2	D
21	408	<i>Technology/Engineering</i>	6.3	A
22	409	<i>Life Science (Biology)</i>	10	B
23	410	<i>Earth and Space Science</i>	2	D
24	410	<i>Physical Sciences (Chemistry and Physics)</i>	2	A
25	410	<i>Earth and Space Science</i>	1	B
26	411	<i>Physical Sciences (Chemistry and Physics)</i>	4	A
27	412	<i>Earth and Space Science</i>	1	C
28	412	<i>Physical Sciences (Chemistry and Physics)</i>	9	D
29	413	<i>Earth and Space Science</i>	7	A
30	413	<i>Physical Sciences (Chemistry and Physics)</i>	7	C
31	414	<i>Life Science (Biology)</i>	16	D
32	414	<i>Physical Sciences (Chemistry and Physics)</i>	2	C
33	415	<i>Life Science (Biology)</i>	2	A
34	416	<i>Life Science (Biology)</i>	9	D
35	416	<i>Earth and Space Science</i>	8	A
36	416	<i>Technology/Engineering</i>	2.2	D
37	417	<i>Life Science (Biology)</i>	2	
38	418	<i>Physical Sciences (Chemistry and Physics)</i>	10	
39	419	<i>Technology/Engineering</i>	5.1	

\* Answers are provided here for multiple-choice items only. Sample responses and scoring guidelines for open-response items, which are indicated by shaded cells, will be posted to the Department's Web site later this year.